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A Clinical Study of Fifty-two Sporadic Cases.

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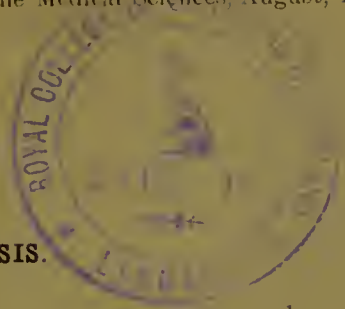

TRICHINOSIS.

A CLINICAL STUDY OF FIFTY-TWO SPORADIC CASES.[1]

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Since the accidental discovery by Frederick Albert Zenker, in 1860, of *Trichina spiralis* as the cause of serious endemics of disease, such endemics and sporadic cases have from time to time been reported in the United States, but trichinosis is usually referred to in the literature as a rarity, and the reports of cases are often so superficial as to argue lack of familiarity with the disease. The fact that I have been able to obtain records of fifty-two sporadic cases occurring during the past six years (observed in my personal practice and in the service of colleagues and myself in the Presbyterian and Bellevue Hospitals) proves that trichinosis is much more common as a sporadic disease than is usually supposed—at least in the vicinity of New York, where there are so many immigrants whose dietetic habits render them liable to infection.

In New York City the Meat Inspectors of the Department of Health direct their examinations mainly to the detection of tuberculous meat, and no systematic microscopic examination is made of the various products of swine flesh.

Owing, moreover, to the frequency with which I have found demonstrable trichinosis unsuspected or wrongly diagnosed, it is my belief that sporadic examples of the disease are much more prevalent than is generally supposed. The following analysis of the fifty-two cases may serve to emphasize the importance of this subject:

In trichinosis the onset of symptoms is acute, either in the form of sudden chills or muscular pains, with vomiting, severe frontal headache, prostration and fever. In a majority of the cases in which the date of infection could be fixed definitely, the onset took place after two weeks' incubation, the extremes being nine days and three weeks. In some cases after an acute onset the patient was better, perhaps

[1] Read at a meeting of the Association of American Physicians, Washington, D.C., May 4, 1910.

able to return to work, when, in a few days, prostration again overtook him.

The vomiting, which is an early symptom in the more severe cases, may be accompanied by intense abdominal cramps and contractures of the leg muscles. Diarrhœa is by no means a constant symptom. I have remarked it as an immediate symptom in several patients who had eaten tainted swine flesh, when it appeared due rather to ptomaine poisoning (botulismus) than irritation by the trichinæ. As a later symptom it characterized about one-fifth of the cases. Others exhibited constipation throughout, or constipation alternating with occasional diarrhœa. Tympanites was often present, and in one case there was hemorrhage from the bowel. Repeated search for trichinæ was made in the stools and blood of the patients, but they were never discovered.

Distinct chills or indefinite rigors were present in about one-fourth of the cases, usually occurring within the first few days of the disease. The chills were followed not infrequently by sweating, and profuse sweats were common throughout the grave cases.

Erythema was often manifest in the face and neck, sometimes also over the body. I have not noticed the general pruritus referred to by one or two writers, but have once or twice observed herpes labialis, urticaria, and a macular eruption on the abdomen, not unlike the roseola of typhoid fever. In one of my cases serious epistaxis occurred.

In all the more severe cases there was early complaint of great muscular weakness and prostration, while, sometimes, but by no means uniformly, there was loss of weight. One patient of the series lost fifteen pounds. As a point of distinction from typhoid fever, the loss of weight is not usually commensurate with the extent or duration of the temperature in trichinosis. The muscle pains and tenderness are usually very general and severe, but in many cases the pains were most intense in special groups of muscles, especially in the arms, calves of the legs, and thighs. Tenderness over the diaphragm was common. In exceptional cases the muscular pains and tenderness were so slight as to be very little complained of, at least at the time when the patient came under observation. In such cases the trichinæ are probably already firmly encysted.

The eye symptoms were interesting. Severe pain and burning sensations in the eyes were usually complained of, and were distinctly localized, independent of the headache. I have seen three cases in which there was circumscribed corneal hemorrhage, bilateral and close to the iris, which probably was due to local irritation by the trichinæ. In one additional case only was vision affected temporarily. There was an optic neuritis with œdema of the retina near the optic nerve, and small hemorrhages in the macular region of the left eye, while the fundus resembled that of acute nephritis. From time

to time small fresh hemorrhages appeared in both eyes, but the process entirely cleared up.

F. J. Parker[2] reported several cases from the Presbyterian Hospital dispensary, among which were four with tenderness of the eye globes on pressure, diplopia, and pain on rotation. In four cases there was conjunctivitis, and in one neuroretinitis with œdema and hemorrhage of the retina. In two there were subconjunctival ecchymoses.

C. Stauble[3] reports a case with subcorneal ecchymosis and Kratz observed this symptom in eight patients in an epidemic of 264 cases in Hedersleben. Dilatation of the pupils has also been recorded.

Œdema of the eyelids was present in one-fourth of the cases of my series, at some time during their course. It may be so slight as to escape the patient's notice, or severe and accompanied by swelling of the cheeks and forehead, so as to make the face resemble the appearance in acute nephritis.

Œdema of the ankles was common, and sometimes there was swelling about such major joints as the knees and elbows, an appearance which often has led to a mistaken diagnosis of rheumatism. The œdema occurs irrespective of the localization of pain.

Cough was present in a number of cases, with slight bronchitis, probably due to irritation of the bronchi by the parasites, but the latter were not found in any of the sputum examined.

Dyspnœa was a very common symptom, but it was usually objective rather than subjective, and unaccompanied by pulmonary signs or cyanosis. It often appeared to be due to invasion of the diaphragm muscle by the trichinæ, for in such cases the abdomen was markedly sore and the type of breathing thoracic. The maximum rate of breathing observed in any case was 60, and in a number of cases it reached 36.

The urine, as a rule, presented few abnormalities, but in some cases scattered red blood corpuscles and a trace of albumin were observed. In one patient a subacute nephritis developed, and in a case seen in consultation there was an acute hemorrhagic nephritis with excessive hemoglobinuria. In this case, however, the urine was also "smoky," as in carbolic acid poisoning, and the patient had been drugged with an excess of potassium iodide and salicylates, in the mistaken belief that he was suffering from obstinate rheumatism. Micturition sometimes is painful. A positive diazo reaction frequently was obtained.

The leukocytosis, as a rule, was not excessive, and apparently never as high as it may be in many purulent infections, pneumonia, gas poisoning, etc. In one-third of the cases it was not above 15,000, and in only three cases was it above 32,000, the maximum being

[2] Medical Record, August 3, 1907, p. 179.
[3] "Trichinosis," Weisbaden, 1909, p. 50.

40,209. Polynucleosis varied from 28 to 87.5 per cent. The lymphocytes varied from 4 to 20 per cent.

Attention was first called to the high percentage of eosinophiles in the blood of patients having trichinosis by the researches of W. S. Thayer and Thomas R. Brown,[4] and it has proved of great diagnostic importance. This percentage was above 20 in thirty-one cases, or considerably more than half the series; it was above 40 in almost one-fourth of the cases, and the highest records were two cases giving 60 per cent., one 52, one 74, and two 81 per cent. In one of the latter the full blood picture was as follows:

Polynuclear cells	14
Large lymphocytes	1
Small lymphocytes	3
Large mononuclear	1
Eosinophiles	81
	100

In another case, with phenomenally high eosinophilia the blood picture showed:

Polynuclear cells	28.6
Transitional cells	0.0
Large mononuclear cells	0.0
Lymphocytes	11.4
Basophiles	0.0
Eosinophiles	60.0
	100.0

In another case there were 28,750 leukocytes, with the following differential count:

Polynuclear cells	16.5
Lymphocytes	5.5
Transitional	4.0
Eosinophiles	74.0
	100.0

In repeated examinations in this case the eosinophiles rose in number as the leukocytosis declined. C. Stauble noticed this relationship in experimental trichinosis in animals. In an experimental research in guinea-pigs, this author[5] produced eosinophilia of 52 per cent. with artificially induced trichinosis, and Kerr[6] reported a case in a man with 86 per cent. of eosinophiles. T. H. Dexter[7] reported cases with eosinophilia up to 68 per cent. H. Albert and H. W.

[4] Lancet, 1897, and Jour. Exper. Med., 1898, No. 3.
[5] "Trichinosis," Weisbaden, 1909.
[6] Phila. Med. Jour., August 25, 1900.
[7] New York State Jour. Med., March, 1910, vol. x, No. 3.

Norris[8] reported a case of trichinosis with an eosinophilia of 72 per cent. J. L. Hirsch[9] reported a house endemic of five cases of trichinosis in one family from eating raw ham. In one of these cases there was 45 per cent. of eosinophilies, and in none was the eosinophilia definitely related to the severity of the symptoms. In one of the five cases of trichinosis reported by Thomas R. Brown[10] the eosinophilia reached 50 per cent., and in another, 49 per cent. The eosinophilia sometimes presented considerable fluctuation during the progress of the disease. Thus, in one case of my series the count fell from 33 per cent. to 7.5 and rose again to 12 per cent. The eosinophilia affords no accurate index of the severity of the symptoms, either as to fever, muscle pains, or otherwise. For example, in one case the eosinophilia was 74 per cent., while the temperature was only 102° F.

One of the most protracted and serious of my cases gave the following blood count (made by Thomas W. Hastings): Leukocytes, total, 10,000; polynuclear cells, 70 per cent.; lymphocytes, 20 per cent.; eosinophiles, 12 per cent. At this time the patient's temperature was 105° F. While he was convalescing, with normal temperature, and no pain or tenderness, the eosinophilia rose to 62 per cent. In another case the eosinophiles numbered only 28 per cent., while the temperature was 105° F. In one case the eosinophiles numbered only 3 per cent. at the time when trichinæ were obtained from the gastrocnemius, although they had previously numbered 10 per cent. at the onset and 24 per cent. subsequently.

In another case the eosinophilia, which was 30 per cent., while the temperature was 104° F., rose to 52 per cent. after the temperature had been normal for ten days. As the cosinophiles accumulate around the encysted trichinæ their percentage may vary with the site from which blood is obtained for examination. For example, in one case blood from the infected muscle area gave 59 per cent., but that from the ear lobe (which was not tender) yielded only 33 per cent. I have been unable to obtain data as to the duration of the eosinophilia after recovery, for the patients usually being well, pass from observation, but one man went home in good health still showing 62 per cent. of eosinophiles, and K. Schleip reported 45.2 per cent. in a convalescent.

Various theories have been advanced regarding the function of eosinophilia. Bazzicalupo[11] discusses the connection between cosinophiles and antibodies in the serum, with the conclusion that they bear a direct relation to the presence of toxins in the blood, being in inverse relationship to the production of antibodies. There are, however, so few diseases of pronounced toxemia in which cosinophiles are notably increased, that their role cannot be very important. They

[8] Jour. Amer. Med. Assoc., November 21, 1908.
[9] Ibid., January 15, 1910.
[10] Med. News, January 7, 1899.
[11] Gaz. degli Ospedale, Milan, xxix, No. 35.

have been found increased under the following conditions (1 to 4 per cent. being normal in adults):

1. In pneumonia, just before the crisis, exceptionally, 5 or 6 per cent.

2. In a few skin diseases of wide distribution, such as dermatitis exfoliativa, pemphigus, psoriasis, prurigo, general eczema, such bulbous eruptions as dermatitis herpetiformis, and in leprosy, in all of which they rarely reach 10 or 12 per cent., and do not long remain at that ratio. James C. Johnston and Hans J. Schwarz report from the Cornell University Medical College Clinic[12] a case of dermatitis herpetiformis with eosinophilia of 9.6 per cent., and one of prurigo of Hebra, with 21 per cent., subsequently falling to 2.6 per cent. No mention is made, however, of the exclusion of possible intestinal parasites as a complication, and in another of their cases of prurigo, the eosinophilia was only 3 per cent. In trichinosis, however, the eosinophilia is not only *invariably* present, but usually in high degree, and remains long. Thomas R. Brown found 24 per cent. of eosinophiles in a case of chronic eczema, and John W. Coe[13] found 51.8 per cent. in a case of pemphigus, 21 per cent. in one of psoriasis, 20 per cent in one of dermatitis herpetiformis, and 18 per cent. in one of psoriasis. In all such exceptional cases, however, the diagnosis is, of course, obvious from the presence of the cutaneous lesion, but care should be exercised to exclude the possible coexistence of intestinal parasites of some kind. Moreover, in cutaneous cases of equal severity, eosinophilia is by no means constant. For example, in a second case of pemphigus studied by Coe, it was absent.

3. With intestinal parasites (other than trichina spiralis). The eosinophilia accompanying uncinariasis, round worms, tapeworms of various species, and other intestinal parasites, is rarely very high, and never so high as in most cases of trichinosis. I have seen it 2.3 per cent. with tenia saginata, and only 1.5 per cent. with ascaris.

4. In bronchial asthma. In an obstinate case of bronchial asthma which I have lately observed in a girl, aged twenty years, the eosinophilia during a paroxysm reached 12 per cent. Repeated examination of the stools failed to reveal evidence of any form of intestinal parasite, and trichinosis was positively excluded. Thomas R. Brown cites a case of bronchial asthma with an eosinophilia of 22.4 per cent.

Ira S. Wile,[14] in a general study of eosinophilia, says that a moderate increase in eosinophiles may be produced exceptionally by such drugs as camphor, potassium iodide, and sodium salicylate, but I have never observed it even when large doses of these drugs were being administered. He also claims that improvement in tuberculosis is accompanied by eosinophilic increase.

[12] New York Med. Jour., March, 1909.
[13] Presbyterian Hospital Reports, New York, 1904.
[14] Med Record, January 29, 1910.

Microscopic examination of sections of muscle were made in various cases from such muscles as the deltoid, biceps, and gastrocnemius.

In twenty-nine cases trichinæ were found, and in five more an acute myositis was present. In the remaining eighteen cases either no examination was made, or no trichinæ were found in the specimen isolated, but in all these cases the other symptoms, such as a high degree of eosinophilia, puffiness of the eyes, dyspnœa, fever and generalized muscular pains and soreness justified the diagnosis, especially as such cases frequently occurred in connection with one or two others, in which the trichinæ were found—that is, among patients simultaneously exposed to infection.

In one case the fragment of biceps muscle examined by Dr. Meakins, of the Pathological Department of the Presbyterian Hospital, showed the encapsulated spirillæ lying between the muscle fibers, each surrounded by a zone of eosinophiles. In two cases small round-cell infiltration of the muscle was recorded, and in another there was infiltration with round and polygonal cells together with eosinophiles. Another case presented between the muscle fibers minute cysts with dense granular contents.

The temperature rise is one of the most interesting symptoms. It is fairly acute and varies from a few days to several weeks in duration—in the longest case of the series ten weeks, in the shortest, three days. In the ordinarily severe cases it remains at a maximum of 104° F. to 104.5° F. for four to five days, when it declines gradually, with daily fluctuations of about three degrees F.

The subsidence is always by lysis. In average cases the temperature consumes from ten to sixteen days in falling from 104° F. to normal, but not infrequently, after falling to 100° F. or 101° F., it remains constant at that low level for many weeks. In one case a temperature between 100° F. and 105° F. lasted ten weeks. In another case the temperature ranged between 101° F. and 100° F. for forty days, and a large number exhibited more or less fever for six weeks. In twenty cases of the series the temperature passed the 104° F. record, in three it was 105° F., and in two, 105.5° F. In more than half of all the cases it rose considerably above 102° F. Despite the high and often protracted fever, the patients usually appear much less ill than with similar grades of fever due to other causes, and are rarely delirious. One of my patients presented a temperature of 105.5° F., an eosinophilia of 62 per cent., and trichinæ in the muscle fragments removed, yet the man had comparatively little muscle soreness throughout, and felt so well at the height of the fever that it was with difficulty he was persuaded to remain in bed.

In a few cases—four or five—after an interval of three or four weeks of apparent recovery, there was a return of symptoms, and in several there was a decided exacerbation of temperature and other

symptoms after their partial decline. As a rule, however, improvement once begun, progresses uninterruptedly, although very slowly.

The nationality of the patients included a wide range. The majority naturally, from their dietetic habits, were foreigners, such especially as natives of Hungary, Poland, Norway, Bohemia, Germany, Austria, and Italy, but not a few were Americans. Six of the private patients whom I have seen were Americans in good social position, victims of infected sausage and potted ham. The previous diet of those patients who could give an intelligent account of it after the long intervening latent period had elapsed, included such foods as raw pork, raw ham, potted ham, imperfectly smoked ham, head cheese, and a variety of sausages.

Albert and Norris, in the article above cited, report an endemic of fourteen cases of trichinosis occurring in 1908 in Grinnell, Iowa, from eating imperfectly boiled ham.

The disease, as met with in this country, is rarely fatal, although the patients may become very seriously ill. There were only two deaths among the entire series of cases presented. One of these occurred in a Pole in my service, who had only 5 per cent. of eosinophiles, while trichinæ were discovered in the deltoid. He acquired erysipelas and pneumonia, which, rather than the trichinosis, were the cause of death. The other patient, the only one in whom the disease may rightly be said to have been the cause of death, died in delirium with respirations of 60, a pulse of 132, dry tongue, and high fever. In this case the maximum eosinophilia was 14.5 per cent.

That the eosinophilia of trichinosis, which is unique in its excess is due to some specific toxin generated through the agency of the parasite, might be argued from the fact that in acute or subacute polymyositis, unattended by trichinosis, it is absent; hence it is not the polymyositis alone which causes it. In one case of this type which I recently observed, and in which trichinosis was definitely excluded, there was no eosinophilia, and in three cases reported by Benjamin T. Burley[15] he had the same experience. On the other hand, if the hypothesis be correct that a specific toxin caused by the agency of the parasite is responsible for the aggregation of eosinophiles, which occurs around the organisms in between the muscle fibers, one would naturally expect the eosinophilia of the blood to be at its maximum before the parasites became encysted and quiescent; yet in many of the cases herein recorded, such was not the fact, notably in that of the patient whose maximum eosinophilia of 62 per cent. was not reached until more than six weeks after his first symptoms appeared, when he was practically well. It is difficult to understand how in such a case the eosinophilic response can be in any sense protective. Moreover, the eosinophilia is entirely independent of definite relationship to either the general leukocytosis or

[15] Jour. Amer. Med. Assoc., January 18, 1908; see also Amer. Jour. Med. Sci., this issue p. 167.

the course of the fever. The question is obscure and experimental evidence is much needed to elucidate it. Some of the tapeworms, notably Dibothriocephalus latus are known to generate specific toxins causing anemia, yet their eosinophilic response is much less than that of trichinosis. In a case of this sort which I have elsewhere reported,[16] the eosinophilia never exceeded 9 per cent., although a condition of pernicious anemia was produced, of extraordinary degree.

Von Leube[17] states that it is impossible to distinguish polymyositis from trichinosis in many cases without examination of excised muscle, and Hepp,[18] in an early account of polymyositis, referred to it as "Pseudo-trichinose," but in the light of recent study the diagnosis ought not to be so difficult even without excision of muscle, for in polymyositis eosinophilia is lacking, as well as the eye pains, marked headache, puffiness of the eyelids, vomiting and peculiar dyspnœa, which characterize all the more severe cases of trichinosis. Apart from polymyositis, those diseases for which trichinosis is most often mistaken are typhoid fever, paratyphoid fever, septicemia, acute rheumatic fever, estivo-autumnal fever, multiple neuritis, and acute poliomyelitis.

The temperature charts of cases of trichinosis very often closely resemble typical charts of typhoid fever in the third and fourth week, and the headache and occasional epistaxis may be confusing, but in trichinosis the patient is usually proportionately less ill and lacks the nervous phenomena of typhoid fever. Moreover, the onset of trichinosis is more acute, with vomiting and muscular pains and cramps. The two diseases may, however, co-exist, as they did in the original case of Zenker, which led him to discover the trichinæ in a routine examination for degenerated muscle fibers in a patient who had died from typhoid fever. Fischer[19] and MacCrae[20] have each reported a case of combined trichinosis and typhoid infection.

Exceptionally, the trichinosis charts may resemble the markedly remittent temperature curve of septicemia or of a estivo-autumnal fever with chills and sweats, but a thorough examination of the blood in all such cases ought to resolve all doubt.

Occasionally, in trichinosis there is swelling about such major joints as the knees and ankles, and this, with the pain caused by voluntary movement and sweating, may give rise to an erroneous diagnosis of rheumatism. I have lately seen a case which had been mistaken for rheumatism for a week, owing to such symptoms, and the fact that the patient a year before had had a typical acute articular rheumatism. The hemorrhages into the cornea led me to suspect the presence of trichinosis, and the latter diagnosis was

[16] Med. News, April 8, 1905.
[17] Medical Diagnosis.
[18] Berl. kin. Woch., 1887, xxiv, 297–322.
[19] Deut. med. Woch., 1898, xxiv, 821.
[20] Amer. Jour. Med. Sci., 1902, cxxiv, 56.

confirmed by finding eosinophilia and the presence of trichinæ in an excised fragment of the gastrocnemius.

I saw another interesting case in a lad, aged eighteen years, in which a diagnosis of rheumatism similary had first been made, for which that of acute poliomyelitis had later been substituted by the physicians in attendance. The latter diagnosis was held because of a recent epidemic of poliomyelitis occurring in the same locality, and the patient suffered such excruciating pains in the extremities that lack of motion was mistaken for paralysis. Having demonstrated that paralysis did not exist, I suspected trichinosis from the slight puffiness of the eyelids and a diaphragmatic type of dyspnœa I obtained a blood examination as follows:

Hemoglobin	85 per cent.	
Erythrocytes	5,032,000	
Leukocytes	24,300	
Polynuclear cells		76.5
Transitional		0.9
Lymphocytes		7.4
Eosinophiles		15.2
		100.0

I found that the patient had eaten poorly cooked "Bolognas" two weeks prior to his illness, and a similar milder case was found in the cook who had partaken of the same food.

To recapitulate: There should be no difficulty in determining promptly a correct diagnosis of trichinosis based upon the observation of the following symptoms:

1. Acute onset usually with vomiting and abdominal cramps.

2. A high grade of eosinophilia, invariably present; usually above 30 per cent., and frequently much higher—even above 80 per cent.

3. A high grade of temperature, often reaching 104° or more, and lasting, in lessening degree, for two to six weeks.

4. Puffiness of the eyelids and face, with pains in the eyes occurring in one-fourth of the cases.

5. Dyspnœa and diaphragmatic breathing occurring without cyanosis in about one-fourth of the cases.

6. The generalized muscle pains, cramps, soreness, and prostration, causing sometimes deceptive apparent immobility.

7. The sudden occurrence of symmetrical circumscribed corneal hemorrhages in a patient whose bloodvessels are not degenerated, should give rise to a suspicion of trichinosis.

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